

**COMPACT MOTION MECHANISM
FOR AN ANIMATED DOLL**

Cross-Reference to Related Application

5 [0001] This application claims priority to Provisional Patent Application Serial No. 60/268,317 filed February 12, 2001 titled "Compact Mechanism for an Animated Doll" which is hereby incorporated by reference.

Field of the Invention

[0002] The present invention relates to a toy doll, and in particular, to a toy doll which has plural, movable facial-expression structures, such as openable and closeable eyes, and an openable and closeable mouth, operated under the influence of a compact single motor and drive mechanism which fits within the hollow interior of the head component in the doll. For illustration purposes, an embodiment of the invention is described herein with specific reference to movable eye and mouth structures -- a setting wherein the invention has shown itself to offer particular utility the invention, as will become apparent, can offer similar utility in relation to other kinds of movable facial-expression structures.

Background and Summary of the Invention

[0003] For many years, animated toy dolls have been popular toys for children. Over these years, more and more sophistication in design has been brought to bear upon the realistic nature of selected animated doll motions in relation to facial-expression structures, and in particular, to such motions which, in addition to appearing to be relatively natural, also occur in a pattern which is not easily learned very quickly by a child -- an event which might too soon lessen the child's interest in continuing to play with a doll.

[0004] Various motorized or electronic dolls are shown in U.S. Patent Nos. 3,298,130, 3,767,901, 3,912,694, 4,139,968, 4,207,704, 4,767,374, 4,825,136, 4,840,602, 4,900,289, 5,141,464, 5,158,492, 5,191,615, 5,281,143, 5,413,516, 5,636,994, 5,820,441,

6,048,209, and PCT Publication No. WO 00/35548, the disclosures of which are all incorporated herein by reference.

[0005] The present invention proposes a very compact, single-motor-driven animation structure effectively mounted within the hollow interior of a doll's head component for opening and closing the doll's eyes and mouth (facial-expression structures) in manners which are relatively realistic. Additionally, the animation structure of the present invention operates in a complex enough pattern that memorization of the pattern is not too likely, especially in the case of young children. The invention also proposes such an animation structure which, in relation to its compactness, is extremely simple, and which can be easily incorporated into an even very tiny doll head component such as, for example, a doll head which might be roughly the size of a golf ball.

[0006] These and other interesting features and contributions which are made by the present invention in the field of animated toy dolls will become more fully apparent as the description which now follows is read in conjunction with the accompanying drawings.

Description of the Drawings

[0007] Fig. 1 is a simplified cut-away drawing of a toy doll (shown only fragmentarily) including a head component wherein movable eye and mouth structures are furnished and driven according to the present invention. In this figure, two graphical lines (a graphical representation) presented at the left side of the figure act as explanatory aids in describing motions that can be produced according to the invention in these eye and mouth structures.

[0008] Fig. 2 is an enlarged, fragmentary, simplified plan view taken generally along the line 2-2 in Fig. 1.

[0009] Fig. 3 is an unfolded (or developed) layout drawing of a rotary drive drum containing driver track structure which is constructed in accordance with the present invention.

[0010] Fig. 4 is a graphical drawing which is similar to the one shown at the left side in Fig. 1, specifically illustrating different phases of motion and positioning in a single cycle of eye and mouth movement produced according to the invention.

[0011] Fig. 5 is very much like Fig. 1, except that, whereas Fig. 1 illustrates the movable eye and mouth structures in conditions with the eyes and the mouth both open, Fig. 5 shows a condition where the eyes are closed and the mouth is open.

[0012] Fig. 6 is like Fig. 1 and Fig. 5, except that here a condition is illustrated wherein the eyes and the mouth are both closed.

[0013] Fig. 7 is similar to Figs. 1, 5 and 6, but illustrates yet another condition in the doll wherein the eyes are open and the mouth is closed.

Detailed Description of, and Best Mode for
Carrying Out, the Invention

[0014] Turning now to the drawings, and referring first of all most particularly to Figs. 1, 2 and 3, illustrated generally at 10 is a fragmentary portion (the head portion) of a toy doll which includes a hollow, typically plastic, molded head component 12. In doll 10, head component 12 is the size roughly of a conventional golf ball. The facial features of this doll head include a forehead 14, eye openings, such as the single eye opening shown at 16, a nose 18, and a mouth 20 which, in Fig. 1, is shown in an open condition. Preferably, the structural material which makes up head component 12 is sufficiently flexible, at least in the region of mouth 20, to enable reasonably realistic opening and closing motion in this region, so that a closed condition for the mouth, such as is illustrated in Figs. 6 and 7, can be achieved simply by producing relative closing motion between the upper and lower lip structure 20a, 20b, respectively, in mouth 20.

[0015] Provided in accordance with the present invention are two articulated-motion, facial-expression structures including an eye structure 22 and a mouth structure 24 which are mounted and disposed within the hollow interior of head component 12.

[0016] Eye structure 22 includes a pair of generally hemispherical movable eye components, such as the single eye component shown at 22a in Fig. 1. These eye components, that are also collectively referred to herein as motion eye structure, are pivotally mounted for rotation reversibly, as indicated generally by double-ended curved arrow 26 in Fig. 1, on a pivot axis 28. Shown at 30, joined to component 22a, and to its counterpart which is hidden in Fig. 1 behind component 22a, is a single, elongate actuator which extends radially away from axis 28, on the opposite side of this axis from the two

eye components. The left end of actuator 30 in Fig. 1 includes what is referred to herein as a track follower 32.

[0017] With up and down motion imparted to follower 32, the actuator rotates the eye structure as indicated by arrow 26 about pivot axis 28, between what is already been referred to herein as open and closed conditions. When the follower and actuator structures are in the positions generally shown for them in Fig. 1, the eye structure sits in what can be thought of as its counterclockwise motion limit condition, which condition defines the mentioned open condition to the eye structure. With upward motion in follower 32, and related motion in actuator 30, the eye structure rotates clockwise about axis 28 in Fig. 1 toward, and finally ending at, a condition similar to that shown in Fig. 5, wherein the eye structure is closed. In this situation, the eye structure is in its clockwise motion limit condition.

[0018] Mouth structure 24 includes an elongate extension element 24a which is disposed appropriately within head component 12 in the region just beneath lower lip 20d. Element 24a directly connects as shown to the lower lip portion 20d in the mouth structure. Extension element 24a extends from a body 24b which is appropriately pivoted on the inside of head component 12 for reversible rotation about an axis shown at 34 in Fig. 1. Axis 34 is disposed below and generally parallel to axis 28, and both of these axes are oriented substantially normal to the plane of Fig. 1. Provided for mouth structure 24 is an elongate actuator extension 36 which has, at its outer end, a track follower 38. With up and down movement of follower 38, as generally indicated by double-ended arrow 40, actuator 36 moves in such a fashion as to cause reversible, limited-angle rocking of the mouth structure about axis 34, such rocking being indicated in Fig. 1 by double-ended, curved arrow 42. This rocking motion is delivered to the mouth lower lip through element 24a.

[0019] With the various components in and associated with mouth structure 24 in the positions illustrated for them in Fig. 1, the mouth structure sits in what can be thought of as its most clockwise rotated condition, and creates an open condition for mouth 20. When this mouth-associated structure is rocked counterclockwise in Fig. 1 to another

rotation limit condition, such as that which is pictured in Figs. 6 and 7, the mouth structure places mouth 20 in a closed condition.

[0020] Illustrated at 44 in Fig. 1 is a two-diameter (or stepped-diameter) cylindrical drive drum body, or rotary drive device, which has an upright long axis shown at 46, and which includes upper and lower, different-diameter end portions 44a, 44b, respectively. Drum 44 is also referred to herein as a rotary interconnect structure. Drum body 44, which is also referred to herein as a shared rotary drive device, is suitably mounted within the hollow interior of head component 12 for rotation about axis 46. End portions 44a, 44b are also referred to herein as cylindrical elements.

[0021] Appropriately formed on, and extending generally circumferentially in a kind of continuous closed-loop fashion about upper drum body end 44a, is an elongate circumferential track 48. This track is defined by upper and lower, spaced, generally parallel walls 48a which define opposite sides of a track groove 48b. Similarly formed on and circumferentially with respect to lower drum body end 44b is another elongate, generally circumferential, closed-loop track 50 which includes spaced side walls 50a that define a track groove 50b. Tracks 48, 50 constitute rotary track instrumentalities herein.

[0022] Further included within the hollow interior of head component 12 according to the invention is a single, small electrical drive motor 52. Motor 52 is appropriately, drivingly connected to rotate drum 44 about axis 46. The drive axis of motor 52 is substantially coincident with axis 46. Suitable electrical connections (not shown) are provided for operating motor 52 from an "on board" electrical power source, such as a battery. Motor 52 may be operated, selectively, either always in one rotary direction only, or, if so desired, reversibly in both directions, and in any one of a number of different rotational patterns over time. These operational patterns which may be selected for motor 52 do not form any part of the present invention, and can be implemented according to designer wishes. In the particular structure now being described, motor 52 is constructed to operate unidirectionally, at a fairly constant speed, and in successive, merge-connected cycles which last throughout a time period selected by the person playing with the toy. Such selection can be implemented either through the closure of an appropriate electrical circuit switch, or may result from other activities such

as positional movements, external sounds, etc. None of these considerations also forms any part of the present invention. The stopping of action can occur by opening of the activation circuit either manually with a switch, or automatically after some period of time, some preset number of cycles, the ending of some event which has triggered operation in the first place, or in many other ways.

[0023] Looking for a moment at Fig. 2 along with Fig. 1, one can see in Fig. 2 generally the relative dispositions of motor 52 and drum 44 from an above point of view taken downwardly along axis 46. Follower 32 on the outer end of actuator 30 is seen extending into groove 48b in track 48. Similarly, follower 38 on the outer end of actuator 36 can be seen to be extending into groove 50b provided in track 50. Motor 52 is also shown in Fig. 2. So also is rotational axis 46.

[0024] Fig. 3 represents a developed, or flattened out, symbolic view of the upper and lower end regions of drum 44. Here one can see generally how tracks 48, 50 are arranged on these two different-diameter drum ends.

[0025] In Fig. 1, and referring now to the graphical image that is presented at the left side in this figure, the dimension C shown there represents the full 360° angular lengths of tracks 48, 50. The reason that the graphical image now being discussed in Fig.

1 looks somewhat different from the mechanical developed view pictured in Fig. 3, is that Fig. 3 actually shows the circumferential relative linear lengths (or dimensions) of tracks 48, 50, whereas the graphical image in Fig. 1 shows the angular circumferential dimensions that relate these two tracks. One can see that, within track 48, there is one region 48c which is the lower-most region pictured in Fig. 1, and another region 48d which is the upper-most region in this track. These two regions are spaced relative to the direction of the longitudinal axis of drum 44, and are joined through angular transition regions (two of them) shown at 48e, 48f. Region 48c is referred to herein also as a low region in track 48, and region 48d as a high region in the track.

[0026] Track 50 is somewhat similar in that it includes two longitudinally-spaced regions -- an upper region 50c and a lower region 50d, connected through angular transition regions shown at 50e, 50f. Region 50c constitutes a high region in track 50, and region 50d a low region in this track.

[0027] As will shortly become apparent, Figs. 5, 6 and 7 include, at their respective left sides, graphical representations like the one shown in Fig. 1. These other graphical representations each relate to the eye and mouth conditions specifically pictured in the associated figure.

5 [0028] With the structure of this invention organized as pictured mechanically in Figs. 1-3 and 5-7, inclusive, during each complete, single, rotary cycle created in drum 44 by motor 52, followers 32, 38 follow the paths defined by tracks 48, 50, respectively. The result of this is that these followers shift generally upwardly and downwardly in Fig. 1, with pauses occurring between successive upward and downward motions, to cause related opening and closing rocking motions in eye structure 22 and in mouth structure 24, along with periods of no eye or mouth movements.

10 [0029] Turning at this point to Fig. 4 in the drawings, and further describing the motion activity just referred to, a complete, single 360° cycle of rotation for drum 44 is illustrated. This cycle defines, effectively, eight different kinds of positional changes and behaviors that are created by tracks 48, 50 for followers 32, 38, respectively. The general "boundaries" of these eight phases are marked by dash-dot vertical lines in Fig. 4, and the lengths of the respective phases are marked by brackets provided in this figure. The dash-dot lines in Fig. 4 are labeled L1-L8, inclusive, and the brackets, which define the nominal spans of these phases, are shown at B1-B8, inclusive.

15 20 [0030] A single cycle of unidirectional operation will now be described in the context of considering that motor 52 rotates drum 44 in a clockwise direction as pictured in Fig. 2. This context further includes that followers 32, 38 are positioned in track grooves 48b, 50b, respectively, at a moment in time just at the end of that phase (or condition) in which both the eye and the mouth structures have been held open (paused) for a period of time during motor operation. This is the status of things pictured in Fig. 1.

25 [0031] 30 Illustrated in each of the graphical image portions of Figs. 1, 5, 6 and 7 is an upwardly pointing arrow 60 which represents a laterally-moving cursor that points to the regions along tracks 48, 50 then occupied by followers 32, 38, respectively. The cycle description now to be given, with clockwise rotation imparted as just described to the drum, causes cursor 60 effectively to progress in a left-moving direction in the graphical

presentations provided in Figs. 1, 5, 6 and 7. It is for this reason that the labeling described above the dashed-dot lines, and the brackets shown in Fig. 4, are given ascending numbers in a progression which is to the left in Fig. 4 along tracks 48, 50.

[0032] At the beginning of the single operating cycle now to be described, the physical positions and conditions of the various components are as pictured in Figs. 1, 2 and 3. Followers 32, 38 ride in tracks 48, 50, and specifically are positioned in these tracks (as indicated in Figs. 1, 2 and 3) with the eye structure and the mouth structure each open. The angular positions of the two followers under these circumstances are especially illustrated in the graphical illustration at the left side of Fig. 1, where cursor arrow 60 points to the positions of these two followers along tracks 48, 50.

[0033] With clockwise rotation produced by motor 52 in drum 44, relative motion occurs between tracks 48, 50 and cursor 60. In particular, this relative motion is such that the cursor moves to the left simultaneously and equiangularly relative to these two tracks. Put another way, the two tracks move as a unit relatively to the right of cursor 60 in Fig. 1. In the several illustrations (Figs. 1, 5, 6 and 7) herein which employ such graphical representations, the positions of the tracks are retained roughly in the same relative location regarding the pictured cut-away head structure, and cursor 60 is shown in respective conditions moved to different angular locations which are to the left of the condition for the cursor shown in Fig. 1.

[0034] Considering now Fig. 4 along with these other figures as an aid in reviewing the operation of the apparatus of this invention, cursor 60 is shown in Fig. 4 in the same position (phase) angularly relative to tracks 48, 50 in which it is shown in Fig. 1. In this phase of a single cycle of operation of the apparatus of the invention, and as has been mentioned earlier, both the eye structure and the mouth structure are in open conditions. Follower 32 sits in low region 48a within track 48 and follower 38 sits within high region 50c in track 50 (see dash-dot line L1). As will become apparent, this positional condition for the followers, the actuators, and the eye and mouth structures exists at the end of one of the basically eight different phases of conditions in the apparatus of the invention, and specifically, at the end of a phase wherein both the eye and mouth structures remain essentially stationary and both in open conditions.

[0035] As rotation in drum 44 now progresses, follower 32 begins to ride upwardly as urged and guided by inclined region 48f in track 48, and follower 38 remains basically in the same vertical position in the next stretch of track 50. This phase of operation, wherein the mouth structure remains open and the eye structure begins to close, is pictured by bracket B1 in Fig. 4. When rotation has taken place angularly to a point which represents the "end" of phase B1 (see dash-dot line L2), follower 32 now sits in high region 48d in track 48, while follower 38 still resides in high region 50c in track 50. In this set of conditions, the eye structure is closed and the mouth structure open. This condition is pictured in Fig. 5.

[0036] There now ensues a phase of operation B2 where, for a period of time, the eye structure remains closed and the mouth structures remains open. This phase begins at line L2 in Fig. 4, ends at line L3, and is reflected by bracketed region B2. Thus, and as was true in the very first phase of operation, the end of which began this description, both the eye and the mouth structure are once again in nonmoving conditions.

[0037] At the end of phase B2, follower 32 remains in high region 48d of track 48, and follower 38 begins descending in downwardly inclined ramp portion 50f in track 50. This phase of operation, which ends at dash-dot line L4 in Fig. 4, is marked by bracket B3 in Fig. 4. This is a phase of operation during which the eye structure remains closed while the mouth structure moves, and specifically moves from an open condition toward a closed condition. This latter condition is pictured in Fig. 6 in the drawings.

[0038] At the end of phase B3, follower 32 is still in high region 48d in track 48, and follower 38 is now in low region 50d in track 50, with the result that the eye structure is still closed, and the mouth structure is now also closed.

[0039] Dash-dot line L4 marks the beginning of the next phase B4 in the condition of the apparatus of this invention -- a phase which ends with dash-dot line L5. In phase B4, both the eye structure and the mouth structure remain stationary, with the eye structure closed and the mouth structure also closed. This is the Fig. 6 condition.

[0040] The next phase to follow is pictured at B5 in Fig. 4, beginning with dash-dot line L5 and ending with dash-dot line L6 in the figure. During this phase, follower 32 is moved downwardly along downwardly inclined portion 48e in track 48, while follower

38 remains unmoved in low region 50d in track 50. Thus, during phase B5, the eye structure changes from a closed to an open condition while the mouth structure remains closed.

[0041] At the end of phase B5, a condition exists where follower 32 is now again in low region 48c in track 48, while follower 38 is still also in low region 50d in track 50. There then follows a phase marked B6 in Fig. 4, beginning with dash-dot line L6 and ending with dash-dot line L7. During phase B6 both the eye and the mouth structures are stationary, with the eye structure open and the mouth structure closed. This condition is illustrated in Fig. 7 in the drawings.

[0042] What next follows is a phase marked B7 in Fig. 4 during which phase follower 32 remains in low region 48c in track 48, while follower 38 begins to move upwardly under the influence of rising ramp portion 50e in track 50. This is a phase during which the eye structure remains open, while the mouth structure transitions from a closed to an open condition. At the end of phase B7, the components in the apparatus of this invention, vis-a-vis the conditions (open or closed of the eye structure and the mouth structure), are the same as those which existed at the beginning of this described single cycle of operation. The phase of operation during which this exists is pictured by bracket B8 in Fig. 4. This phase begins with dash-dot line L8 and ends with previously-mentioned dash-dot line L1 which, because of the developed-view nature of Fig. 4, appears both at the left and right sides of this figure. During phase B8, follower 32 remains in low region 48c in track 48, while follower 38 remains in high region 50c in track 50. In this phase, both the eye and the mouth structures are held stationary in open conditions.

[0043] It can thus be seen how, in a single, unidirectional cycle of rotation and operation of motor 52 and drum 44, a fairly complex and quite natural series of phases of eye openings, eye closings, mouth openings, mouth closings, accompanied by times when both the eyes and mouth are stationary in respective different open or closed conditions, takes place. The operation specifically described contains generally eight different phases of operation, with four phases involving nonmoving conditions in the eye structure and mouth structure, interleaved by four other phases where one but not the

other one of these two structures is put into motion between an open and a closed condition, or vice versa.

[0044] The pattern of operation just described can also be seen to be one which is not easily quickly memorized, and one which, depending upon the particular starting set of positions for the various components in the mechanism of this invention, cannot easily be predicted -- vis-a-vis what is next to happen. This statement, of course, assumes that operation of the apparatus of the invention can be stopped at any point in any one of its different phases, and this is an operating condition which the invention readily accommodates, and which is truly a matter of designer choice. Another option, of course, would be to have the components of the mechanism of this invention always advance to and stop in a particular selected starting and stopping condition each time that it is started and stopped. Other patterns of operation can, of course, be chosen at the selection of a designer of a doll employing this invention.

[0045] Further, the patterns described by tracks 48, 50 on and around the circumferences of drum ends 44a, 44b, can take on a host of different characteristics to produce a very different set, or very different sets, of patterns of interrelated opening and closing operations for the eye and mouth structures. For example, the number of times that opening and closing occurs in a single 360° turn of drum 44, and the angular rotational conditions during which changes takes place, or constancy holds, can be modified easily from design to design. So also can be the amount of vertical travel produced in the followers by vertical changes in the angular positions of the relative associated tracks.

[0046] The fact that, in the mechanism proposed by this invention, the up and down directions in which the followers move is mimicked by the up and down movements of the eye and mouth structures leads to overall simplicity in the structure of the invention. By stepping the diameter of the different drum regions that carry tracks, and by selecting the locations of horizontal pivot axes 28, 34, and all in relation to, selecting the lengths of actuators 30, 36, the apparent relative amounts of opening and closing motions that are producable in the eye and mouth structures are readily varied from design to design.

[0047] The structure of this invention, as can clearly be seen, involves a very few, relatively simply manufactured components, which may be molded plastic components. Also, the invention requires only a single, tiny electrical drive motor. These factors yield a structure which is easily miniaturized enough to fit within the hollow interior of an even very small doll head.

[0048] Without making any appreciable changes in the mechanical constructions of the eye and mouth structures, the actuators, the followers, the drum and the tracks herein, but simply by allowing motor 52 to operate bidirectionally, either by direct user selection, or in scheduled alternation, or even in random alteration, the patterns of eye structure and mouth structure openings and closings can be made to be far more complex. Such further complexity would thus make it far more difficult, almost to the point of impossibility, to predict what the next action will be, particularly on start-up of motion if that start-up is also initiated in a kind of random fashion.

[0049] Accordingly, a unique animated doll head mechanism, with a sophisticated, difficult to memorize and yet quite realistic set of motions, all employable in very tiny doll head structures, is proposed by the present invention. This mechanism, while offering, as stated earlier herein, special utility with respect to working with movable eye and mouth structures, can also be employed to work with other kinds of facial-expression structures.

[0050] It is believed that the following claims particularly point out certain combinations and subcombinations that are directed to one of the disclosed inventions and are novel and non-obvious. Inventions embodied in other combinations and subcombinations of features, functions, elements and/or properties may be claimed through amendment of the present claims or presentation of new claims in this or a related application. Such amended or new claims, whether they are directed to a different invention or directed to the same invention, whether different, broader, narrower or equal in scope to the original claims, are also regarded as included within the subject matter of the inventions of the present disclosure.